Sept. 10, 1957 A. TARCICI 2,806,134

COLLAPSIBLE REFLECTORS

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FIG. 1.

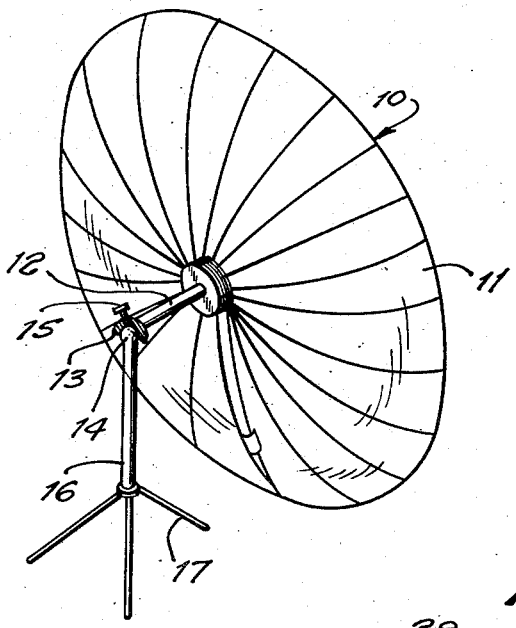


FIG. 2.

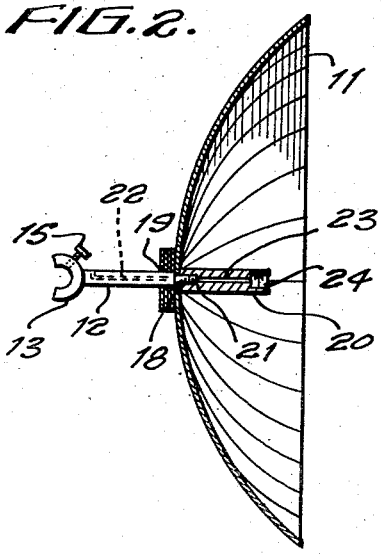
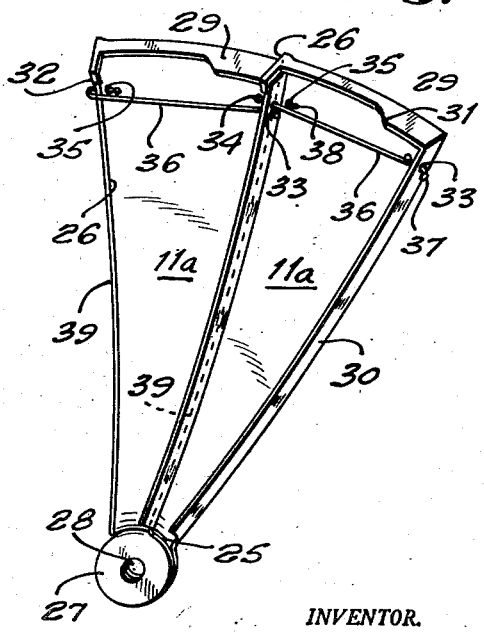


FIG. 3.



INVENTOR.
ADNAN TARCICI
BY

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COLLAPSIBLE REFLECTORS

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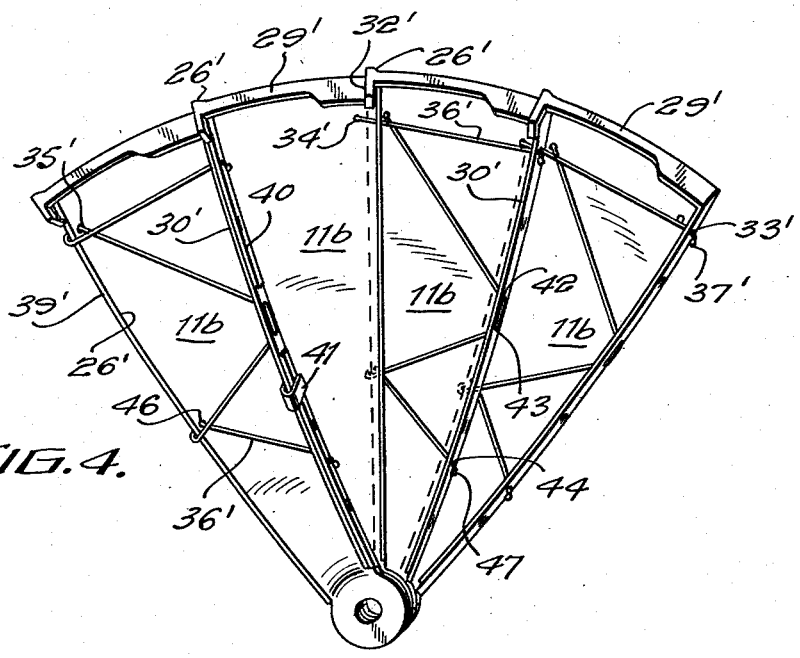

FIG. 4.

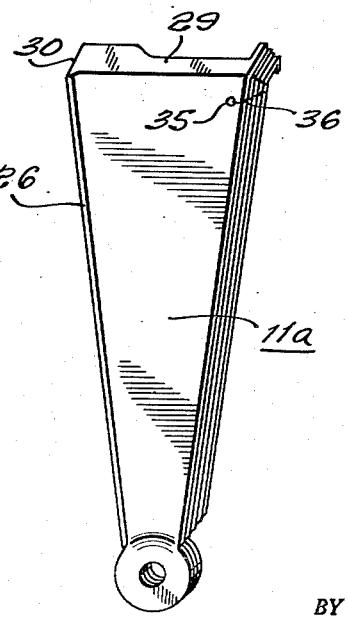

FIG. 5.

INVENTOR.
ADNAN TARCICI
BY

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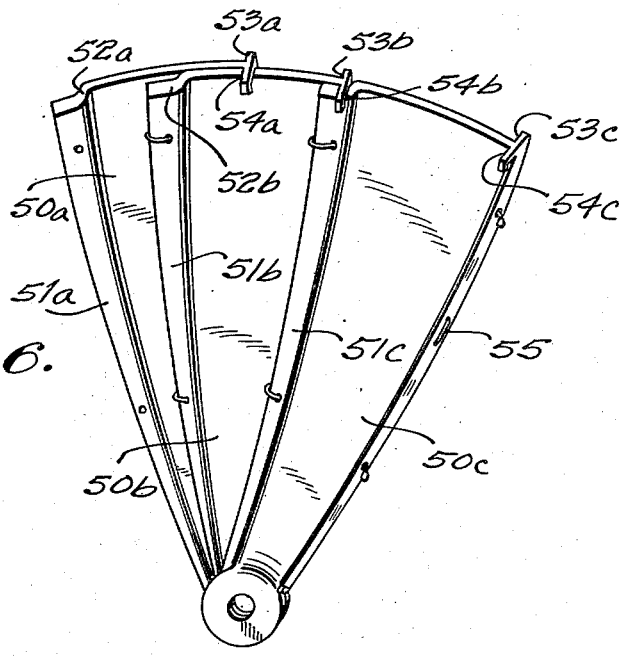

FIG. 6.

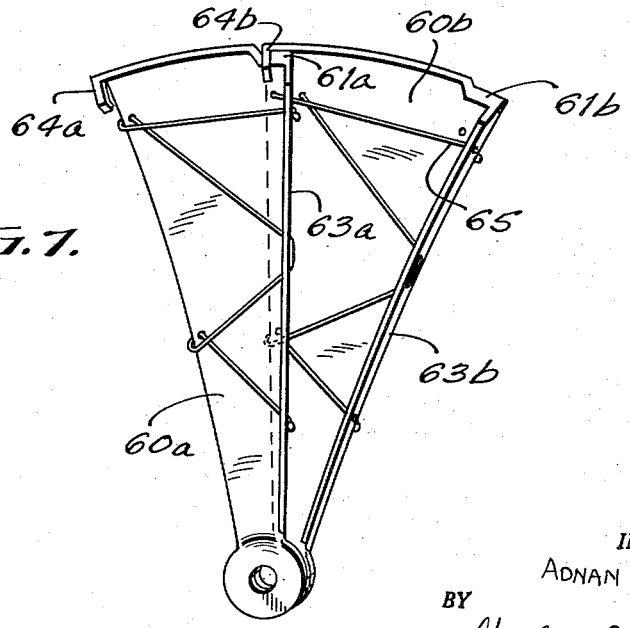

FIG. 7.

INVENTOR.
ADNAN TARCICI
BY

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2,806,134

COLLAPSIBLE REFLECTORS

Adnan Tarcici, Halba Akkar, Lebanon

Application July 8, 1952, Serial No. 297,744

Claims priority, application Switzerland August 27, 1949

8 Claims. (Cl. 240—103)

The present invention relates to reflectors.

More particularly, the present invention relates to reflectors capable of being collapsed so as to consume a small space when not in use and capable of being expanded into an operating position, these reflectors being adapted either for concentrating rays from a predetermined source onto a given object or for distributing the rays from a source located in a predetermined position with respect to the reflector. For example, reflectors of the type to which the present invention relates may be used for photographic purposes, they may be used for concentrating the rays of the sun upon an article to be heated, or they may be used as reflectors for search lights and the like.

The present application is a continuation-in-part of U. S. application Serial No. 275,530, filed March 8, 1952 and entitled, "Solar Heating Apparatus," now Patent No. 2,770,230, which in turn is a continuation-in-part of U. S. Patent No. 2,760,482, issued August 28, 1956, and entitled "Sun-Operated Heating Devices."

It is an object of the present invention to provide a simple and effective means for interconnecting reflector segments in such a way that they are movable between a collapsed position, when the reflector is not in use, and an expanded position when the reflector is in use.

A further object of the present invention is to prevent any possibility of scratching the reflecting surfaces of the segments of a collapsible reflector during movement of the latter between its expanded and collapsed positions.

Another object of the present invention is to provide reflector segments of the above type which form a substantial continuation of each other in their expanded position.

An additional object of the present invention is to provide a means for substantially eliminating free spaces between reflector segments of the above type when they are in their expanded position.

With the above objects in view, the present invention mainly consists of a reflector having a plurality of sector-shaped segments. These sector-shaped segments respectively have apex portions located over each other and connected together for turning movement with respect to each other, about a central reflector axis passing through the apex portions of the segments, into and out of a collapsed position where the segments are located over each other and where a pair of the segments are respectively located at opposite ends of the plurality of segments. A flexible means interconnects these segments for automatically moving the same into an expanded position, where said segments form a substantially continuous reflecting surface and are in approximate edge to edge relationship, upon movement of one of the said pair of segments about the reflector axis toward the other of the said pair of segments.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

Fig. 1 is a partially diagrammatic, isometric view of a reflector constructed in accordance with the present invention and seen from the rear side thereof;

Fig. 2 is a side, partly sectional view of the reflector of Fig. 1 and its associated structure;

Fig. 3 is a rear view of a pair of segments of a reflector, as illustrated in Figs. 1 and 2, showing one possible structure for interconnecting these segments;

Fig. 4 is a rear view of a plurality of segments of a reflector, as illustrated in Figs. 1 and 2, showing another possible structure for interconnecting these segments;

Fig. 5 is a view of the reflector segments in the collapsed position thereof;

Fig. 6 shows three segments of a different type of reflector from those illustrated above, as viewed from the front of the reflector; and

Fig. 7 shows two segments of yet another embodiment of a reflector constructed in accordance with the present invention, as seen from the rear side of this reflector.

Referring now to the drawings, there is shown in Fig. 1 a reflector **10** of the parabolic type, made up of a plurality of similar sector-shaped segments **11** supported for turning movement about the axis of a bar **12**. This bar **12** extends along the central reflecting axis of the reflector **10** and carries at its end behind reflector **10** a socket **13** associated with a ball **14** to form a ball and socket joint therewith so that the reflector **10** is universally adjustable. A screw **15** threadedly extends through the socket **13** and may be turned into engagement with the ball **14** to releasably hold the reflector **10** in an adjusted position. The ball **14** is located at the top of a post **16** which is carried by three legs **17** that are fixedly connected to the post **16**.

As is shown in Fig. 2 the reflector segments **11** turn on end portion **18** of bar **12** which is outwardly threaded and which is connected to the remainder of bar **12** by a shoulder **19**. A second bar member **20** is formed with an internally threaded bore **21** at one end thereof which threadedly engages part **18** of bar **12** so as to guide the turning movement of segments **11**, to be described below, and so as to cooperate with shoulder **19** to prevent movement of the reflector along the length of bar **12**.

The bar **12** is formed with an internal bore **22** extending through the same, and this bore **22** is aligned with a bore **23** of the bar **20**, the latter being provided with an internally threaded end portion **24** adapted to support an electrical bulb or the like. The bores **22** and **23** are adapted to accommodate electrical leads for such a bulb or the like. When a light source is mounted on the bar **20**, the apparatus may be used for distributing the rays from such a light source. On the other hand, an article to be heated may be mounted on the bar **20** and the reflector **10** would then concentrate rays of the sun, for example, on such an article.

The several reflector segments are interconnected in such a way that they are movable between an expanded position, as shown in Fig. 1, and a collapsed position (Fig. 5) where the segments are located in a nesting relationship over each other. One possible manner of interconnecting the segments is illustrated in Fig. 3 where a pair of segments **11***a*, which are part of a series of segments forming a reflector **10**, are illustrated. Each of the segments **11***a* has a first side edge portion **25** and a second side edge portion **26**. The segments **11***a* are shown in Fig. 3 in their expanded position. The side edge portions **25** and **26** of each segment **11***a* together form an apex portion **27**, formed with an opening **28** through which

part 18 of bar 12 extends, these apex portions of the segments 11a being located over each other.

Each of the segments 11a has a rearwardly extending, peripheral flange portion 29 and a rearwardly extending side flange portion 30 extending along the side edge portion 25 thereof. The flange portions 29 are narrower at side portions 26 than at side portion 25, these different widths of flanges 29 merging into each other at part 31 of the flange portions 29. At the narrower ends of flanges 29, the latter are each provided with an integral, substantially hook-shaped extension 32 which is located over the rear edge of the flange 29 of an adjacent segment 11a.

Each side flange 30 is provided with an opening 33, and adjacent to this opening the segments 11a are each formed with an opening 34. Also, the side edge portions 26 of segments 11a are each formed with an opening 35. A flexible cord 36 of a relatively soft, yieldable material is associated with each segment 11a. Each of the cords 36 has an enlarged end 37, which may be a knot or any suitable rigid member clamped to the cord 36, larger than opening 33 and located next to the same. The cord 36 extends from the outer face of flange 30 of each segment 11a, where the enlargement 37 is located next to opening 33, through the latter opening, along the rear face of the segment 11a, through the opening 33 of the next segment 11a, then through the opening 34 of this next segment 11a onto the front reflecting face at side edge portion 26 of the first segment 11a, through the opening 35 of the latter, and onto the rear face thereof. In the example shown in Fig. 3, the cords 36 are maintained taut by an enlargement 38 in the form of a knot larger than opening 35 located on the rear face of each segment 11a next to the opening 35 thereof.

Thus, the cords 36 remain in a substantially stationary position with respect to the respective segments on which they are mounted. In the example of Fig. 3, when the left segment 11a is moved into a collapsed position over the right segment 11a, the openings 33 and 34 of this left segment 11a simply move along that part of cord 36 which extends along the rear face of the right segment 11a. Each pair of adjacent segments 11a is interconnected in this manner, and a cord 36 is shown associated with the left segment 11a of Fig. 3 to connect the latter to the next segment of the series which together form a reflector 10. It will be noted that the knot 38 engages the front reflecting face of the left segment 11a of Fig. 3 to prevent this front reflecting face from contacting the rear face of the right segment 11a of Fig. 3 so that the reflecting faces of the segments are in this way prevented from being scratched. The soft material of the cords 33 is incapable of scratching the reflecting faces of the segments.

When the segments 11a are moved into their expanded position, each hook-shaped portion 32 thereof moves over the edge portion 31 of flange 29 of an adjacent segment 11a and engages the wider portion of the latter so as to press the side portion 26 of one segment 11a toward the front face and over the side portion 25 of an adjacent segment 11a. The knot 38 is located directly beside these portions 25 and 26 of adjacent segments when they are in their expanded position, and the side portion 26 is formed with a raised part 39 located forwardly of the front reflecting face of each segment 11a, so that when the latter are in their expanded position their reflecting faces are substantially located in a single plane, which is parabolic in the structure illustrated. The hook-shaped parts 32 are relatively narrow so that they do not prevent, to any great extent, the compact nesting of the segments into a small space when the reflector is collapsed.

Fig. 5 illustrates the segments 11a in their collapsed, nested position. It is seen that in the collapsed position of segments 11a, they are located over each other with a pair of these segments respectively located at the front and rear ends of the plurality of segments. The front segment visible in Fig. 5 does not have an opening 34. The cord 36 mounted on this front segment 11a passes however through the opening 34 and opening 33 of the segment next to this front segment 11a, these openings 33 having portions of two cords 36 passing therethrough.

In Fig. 4 there is shown another embodiment of the invention which is identical with that described above except for the manner of mounting the cords 36'. The segments 11b of Fig. 4 have the parts thereof which correspond to features of segments 11a indicated by the same numerals primed. Fig. 4 also illustrates the manner in which the first and last segments are connected to each other, and this construction is identical with that of Figs. 3 and 5. Thus, the first segment 11b does not carry a cord 36', while the last segment 11b does carry a cord 36' and is identical with the rest of the segments 11b. This first segment 11b, which is the second one from the right shown in Fig. 4, carries an extra rearwardly extending side flange 40 along side edge portion 26' thereof, and this side flange 40 carries a substantially U-shaped clip 41 adapted to slip over the side flange 30' of the last segment 11b so as to hold the segments in their expanded positions. The segments 11b are identical with the segments 11a except that their side flanges 30' are formed with additional openings 42, 43 and 44. Also they are formed at their side edge portions 26' with an additional opening 46. The cords 36' are longer than the cords 36 and interconnect the segments 11b in the same way that cords 36 interconnect the segments 11a, except that the cords 36' after passing through openings 35' extend along the rear of their respective segments 11b, through the opening 42, along the outer face of side flange 30', then through opening 43 and back along the rear face of their respective segment 11b, between the same and the next segment 11b, about the side edge portion 26' of their respective segments 11b, onto the front face of the side edge portion 26' thereof, through the opening 46, back along the rear face of their respective segments 11b, and through the opening 44 onto the outer face of the side flange 30'. These cords 36' are each provided with an enlarged portion 47, which may be a knot or the like, larger than opening 44 and located next to the same to maintain the cord 36' taut.

Thus, with the embodiment of Fig. 4, the enlarged portions of the cords 36' are located only on the outer faces of flanges 30', and a much larger length of cords 36' is provided to separate the front faces of the segments 11b from the rear faces of the adjacent segments so that the embodiment of Fig. 4 very effectively prevents scratching of the reflecting faces of the segments 11b.

The above-discussed reflector embodiments may be made of any suitable material such as stamped metal provided with a suitable coating, or the like, to give the reflector segments shiny reflecting surfaces. It is also possible to construct the reflector segments of plastic materials such as, for example, Lucite, and in this latter case the plastic material is coated and lacquered on its rear face to produce the necessary reflection.

Figs. 6 and 7 illustrate two different types of reflectors which are particularly well adapted to be made of plastic materials, such as Lucite and the like, although if desired the constructions illustrated in Figs. 6 and 7 may be made of stamped metals, or the like. The embodiments of Figs. 6 and 7 are somewhat simpler than those of Figs. 1–5 in that the reflector constructions of Figs. 6 and 7 do not include anything corresponding to any top flanges 29, 29' of the above described embodiments.

In Fig. 6 there are shown three segments 50a, 50b and 50c of a series of segments of a parabolic reflector adapted to accomplish the same results as the above-described reflectors. These segments are illustrated as seen from their front reflecting faces, and they each have an apex portion at the center of the reflector, these apex portions

being located over each other and the segments 50*a*, 50*b* and 50*c* (as well as the additional segments of the series of segments) being movable from a collapsed position, where the segments are located over each other, to an expanded position, illustrated by the relationship between the segments 50*b* and 50*c*. Segment 50*a* is shown between its collapsed and expanded positions with respect to segment 50*b*.

Each of the segments 50*a* and 50*b* and 50*c* is provided, on its left side as viewed in Fig. 6, with a forwardly raised side edge portion 51*a* and 51*b* and 51*c*, respectively. These side edge portions are connected to the remainder of their respective segments by inclined portions 52*a*, 52*b* and 52*c*, these inclined portions gradually increasing in thickness as they approach the side portions 51*a*, 51*b* and 51*c*. The latter side portions are thicker than the remainder of their respective segments. Each of the segments 50*a*, 50*b* and 50*c* is provided at its right hand side, as viewed from Fig. 6, with a rearwardly extending side flange 53*a*, 53*b* and 53*c*, respectively, and at its top peripheral portion with a forwardly extending hook-shaped member 54*a*, 54*b* and 54*c*. The segments 50*a*, 50*b* and 50*c*, including the above described parts thereof, are all adapted to be molded in one piece when made of a suitable plastic, such as Lucite.

The hook-shaped members 54*a*, 54*b* and 54*c* extend forwardly of the front reflecting faces of the segments by a distance equal to the thickness of side portions 51*a*, 51*b* and 51*c*. Thus, when the segments are not in their expanded position, as is illustrated by segments 50*a* and 50*b* of Fig. 6, the hook-shaped parts thereof extend beyond the front face of the segments, and the latter are very easily moved with respect to each other, as shown by the relationship between the hook-shaped part 54*a* of segment 50*a* and the segment 50*b*. When the segments are moved into their expanded position, the plastic material thereof, which is fairly resilient, permits them to snap into the position illustrated by segments 50*b* and 50*c* of Fig. 6, and in this position the hook-shaped parts 54*a*, 54*b*, 54*c* snugly slide against the front face of edge portions 51*a*, 51*b*, 51*c* and hold the segments in a predetermined expanded position. The rear faces of side edge portions 51*a*, 51*b*, 51*c* form an extension of the front reflecting face of the remainder of their respective segments so that, when the segments are located in the expanded position illustrated by segments 50*b* and 50*c* of Fig. 6, all of the segments very accurately have their front reflecting faces located in a single parabolic plane so that the focal point of the reflector may be very accurately determined.

As is shown in Fig. 6, the segments are each provided with openings in the same way as the segments of Fig. 4, and through these openings are threaded strings or cords 55 in exactly the same way as is illustrated in Fig. 4, so that these strings prevent scratching of the reflecting surfaces of the segments when the latter are moved between their collapsed and expanded positions. The strings or cords 55 are made of a soft, highly yieldable material which is very easily compressed between the overlapping side edges of the segments in their expanded position, so that the cords 55 do not materially affect the location of the reflecting faces of the segments in a single parabolic plane.

When the segments illustrated in Fig. 6 are in their expanded position, there will be, between the segments on the front face of the reflector, raised portions out of the plane of the reflector, produced by the side edge portions 51*a*, 51*b* and 51*c*. In order to eliminate such raised portions, the structure of Fig. 7 may be used. The segments 60*a* and 60*b* of Fig. 7 are molded in one piece of plastic and are provided with rearwardly extending hook-shaped members 64*a* and 64*b* which are adapted to snugly engage the thicker side edge portions 61*a* and 61*b* of the segments 60*a* and 60*b*. The side flanges 63*a* and 63*b* are located at these thicker side edge portions, and the segments 60*a* and 60*b* are formed with openings, in the same way as the segments of Figs. 4 and 6, and have the strings or cords 65 threaded through these openings in exactly the same way as the structure illustrated in Fig. 4. Segments 60*a* and 60*b* are shown from the rear in Fig. 7.

As is apparent from Fig. 7, when the segments of this embodiment are in their expanded position, their front reflecting faces form one continuous reflecting surface which is uninterrupted and located in a single parabolic plane, the front faces of side edge portions 61*a* and 61*b*, in the embodiment of Fig. 7, forming an extension of the rear face of segments 60*a* and 60*b*, respectively, to enable this result to be produced. The hook-shaped parts 64*a* and 64*b* extend rearwardly of the rear face of the segments 60*a* and 60*b* by a distance equal to the thickness of side edge portions 61*a* and 61*b* so that the segments move quite easily with respect to each other as they are moved out of their collapsed position to finally snap into the position illustrated in Fig. 7, where the resilient hook members 64*a* and 64*b* engage the thicker side edge portions of their adjacent segments, respectively, only at the end of the movement. As was the case with the above described embodiments, the strings 65 prevent scratching of the reflecting faces of the segments and are highly compressible so that they do not materially affect the continuity between the reflecting faces of the segments when the latter are in their expanded position.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of reflectors differing from the types described above.

While the invention has been illustrated and described as embodied in collapsible reflectors, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention, and, therefore such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. A reflector, comprising, in combination, a plurality of sector-shaped segments each having a pair of opposite side edges together forming an apex portion of each segment, said apex portions being located over each other and connected together for turning movement with respect to each other, about a central axis passing through said apex portions of said segments, between a collapsed position, where said segments are located over each other and where a pair of said segments are respectively located at opposite ends of said plurality of segments, and an expanded position, where said segments form a substantially continuous reflecting surface and where a side edge portion of each segment overlaps a side edge portion of an adjacent segment, upon movement of one of said pair of segments about said axis toward the other of said pair of segments, each of said segments having an outer flanged edge portion forming a part of the periphery of the reflector and being narrower at one side edge of each segment than at the opposite side edge thereof, said flanged edge portions of said segments overlying each other when said segments are in said collapsed position thereof and each of said flanged edge portions of said segments being provided at the narrower part thereof with a substantially hook-shaped extension extending over the flanged edge portion of an adjacent segment so as to engage the wider part of said flanged edge portion to press said side edges

of said segments toward each other when the latter are in said expanded position thereof.

2. In a collapsible reflector, in combination, a pair of sector-shaped segments each having a front reflecting face and a rear face and each having a first side edge portion and a second side edge portion together forming an apex portion for each segment, said apex portions being located over each other and connected together for turning movement with respect to each other, about the central axis of said reflector, between a collapsed position where said segments are located over each other and an expanded position where one of said segments forms an extension of the other of said segments and is located with the second side edge portion thereof over the front face of said other segment and overlapping the first side edge portion of the latter, each of said segments having a rearwardly extending flange, located along said first side edge portion thereof and having an outer face forming an extension of said front face thereof, and each of said segments being formed with a first opening passing through said flange thereof, said other segment being formed with a second opening adjacent said flange and first opening thereof and said one segment being formed with a second opening passing through said second side edge portion thereof; a cord having an enlargement larger than said first opening located on said outer face of said flange of said one segment, said cord successively passing from said outer face of said flange of said one segment through said first opening of said one segment, along the rear face of the latter, through said first opening of said other segment, through said second opening of said other segment, over the front face of said one segment, through said second opening of said one segment, and onto the rear face of said one segment between said second side edge portion of the latter and said front face of said other segment; and means associated with said cord for maintaining the same in a substantially taut condition.

3. In a collapsible reflector as defined in claim 2, said one segment being formed with third and fourth openings passing through said flange thereof, with a fifth opening passing through said second side edge portion thereof, and with a sixth opening passing through said flange thereof, and said cord successively passing from said second opening of said one segment, along the rear face thereof through said third opening thereof, along said outer face of said flange thereof through said fourth opening thereof, along the rear face of said one segment, about said second side edge portion thereof onto the front face thereof, through said fifth opening onto the rear face thereof, along said rear face thereof and through said sixth opening onto the outer face of said flange thereof.

4. In a collapsible reflector as defined in claim 3, said means associated with said cord for maintaining the same in a substantially taut condition taking the form of an enlargement on said cord larger than said sixth opening and located against said outer face of said flange next to said sixth opening.

5. In a collapsible reflector as defined in claim 2, said means associated with said cord for maintaining the same in a substantially taut condition taking the form of an enlargement on said cord larger than said second opening of said one segment and located on the rear face of the latter next to said second opening thereof.

6. In a collapsible reflector as defined in claim 2, said second side edge portion of said one segment being raised forwardly of the front surface of said one segment so that the latter forms a substantial continuation of the plane of said other segment.

7. A reflector comprising, in combination, a plurality of sector-shaped segments each having a pair of opposite side edges together forming an apex portion of each segment, said apex portions being located over each other and connected together for turning movement with respect to each other, about a central axis passing through said apex portions of said segments, between a collapsed position, where said segments are located over each other and where a pair of segments are respectively located at opposite ends of said plurality of segments, and an expanded position, where such segments form a substantially continuous reflecting surface and where a side edge portion of each segment overlaps a side edge portion of an adjacent segment, upon movement of one of said pair of segments about said axis toward the other of said pair of segments, each of said segments having an outer peripheral surface portion forming part of the periphery of the reflector and being narrower at one side edge of each segment than at an opposite side edge thereof and each of said segments being provided at the narrower part of said peripheral surface portion thereof with a substantially hook-shaped extension extending over the peripheral surface portion of an adjacent segment and beyond the peripheral surface portion of the adjacent segment by a distance substantially equal to the thickness of the wider part of each peripheral surface portion to engage the wider part of said peripheral surface portion to press said side edge portions of said segments toward each other when the latter are in said expanded position thereof.

8. A reflector comprising, in combination, a plurality of sector-shaped segments each having a pair of opposite side edge portions together forming an apex portion of each segment, each of said segments having a front face and a rear face and one of said side edge portions of each segment having a front face portion located to the rear of the remainder of said front face of each segment by a distance approximately equal to the thickness of the other of said side edge portions of each segment, said apex portions being located over each other and connected together for turning movement with respect to each other, about a central reflector axis passing through said apex portions of said segments, into and out of a collapsed position where said segments are located over each other and where a pair of said segments are respectively located at opposite ends of said plurality of segments; and flexible means interconnecting said segments for automatically moving the same into an expanded position, upon movement of one of said pair of segments about said axis toward the other of said pair of segments, where said side edge portions of said segments overlap each other and where each of said other side edge portions of each segment has its rear face located against said front face portion of said one side edge portion of each segment to thereby provide a continuous unstepped reflecting surface.

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